

WHAT IS CLAIMED IS:

1 1. An image display apparatus, comprising:
2 a source unit to generate a spatially uniform light beam that
3 propagates along a first beam path in a first direction;
4 an imaging unit to collect and focus the light beam, wherein the
5 imaging unit includes;
6 a first refractive optical element disposed in the first beam
7 path,
8 a second refractive optical element disposed in the first
9 beam path,
10 a first reflecting mirror disposed in the first beam path,
11 and
12 a second reflecting mirror disposed in a second beam path
13 defined by the first reflecting mirror and the second reflecting mirror,
14 wherein the second beam path is oriented in a second direction
15 different from the first direction, and wherein the second reflecting
16 mirror has a concave reflecting surface;
17 a digital micromirror device ("DMD") to receive the light beam
18 reflected by the second reflecting mirror and disposed in a third beam path
19 defined by the second reflecting mirror and the DMD, wherein the third beam
20 path is oriented in a third direction different from the second direction; and
21 a projection lens to collect and project the light beam reflected
22 from the DMD and disposed in a fourth beam path defined by the DMD and
23 the projection lens, wherein the fourth beam path is oriented in a fourth
24 direction different from the third direction.

2. The image display apparatus of claim 1, wherein the second beam path forms a first lateral angle of about 60 degrees to about 62 degrees with respect to the X axis and a first tilt angle of about -114 degrees to about -116 degrees with respect to the Y axis.

3. The image display apparatus of claim 1, wherein the third beam path forms a second lateral angle of about -74 degrees to about -76 degrees with respect to the X axis and a second tilt angle of about 64 degrees to about 66 degrees with respect to the Y axis.

4. The image display apparatus of claim 1, wherein the fourth beam path forms a third lateral angle of about 90 degrees with respect to the X axis and a third tilt angle of about -79 degrees to about -81 degrees with respect to the Y axis.

5. The image display apparatus of claim 1, wherein the source unit comprises a light source defining a first end of the first beam path; a lamp reflector to collect and reflect light generated by the light source; a color wheel to selectively transmit red, green, and blue components of the light beam; and a light integrator disposed in the first beam path.

6. The image display apparatus of claim 1, wherein the first refractive optical element is a first lens having at least one aspheric surface and having an effective focal length of about 16 mm, and wherein the second refractive optical element is a second lens having at least one aspheric surface and having an effective focal length of about 16.3 mm.

7. The image display apparatus of claim 1, wherein the effective focal length of second mirror is about 30 mm to about 32 mm.

1 8. The image display apparatus of claim 1, further comprising:

2 a housing to house the source unit, the imaging unit, the DMD,
3 and the projection lens, wherein a length of the housing is about 160 mm to
4 about 180 mm, a width of the housing is about 140 mm to about 150 mm, and
5 a height of the housing is about 60 mm to about 70 mm.

1 9. A projection system, comprising:

2 a source unit to generate a spatially uniform light beam that
3 propagates along a first beam path in a first direction;
4 an imaging unit to collect and focus the light beam, wherein an
5 optical beam path in the imaging unit comprises the first beam path, a second
6 beam path, a third beam path, and a fourth beam path; and
7 a projection lens, wherein
8 the first beam path is defined by the source unit and a first
9 reflecting mirror, the second beam path is defined by the first reflecting mirror
10 and a second reflecting mirror, the third beam path is defined by the second
11 reflecting mirror and a digital micromirror device, the fourth beam path is
12 defined by the DMD and a projection lens to collect and project the light beam
13 reflected from the DMD, and said second reflecting mirror is a concave mirror.

1 10. The projection system of claim 9, wherein

2 the second beam path is oriented in a second direction different
3 from the first direction,
4 the third beam path is oriented in a third direction different from
5 the second direction, and
6 the fourth beam path is oriented in a fourth direction different
7 from the third direction.

1 11. The projection system of claim 10, wherein the second beam
2 path forms a first lateral angle of about 60 degrees to about 62 degrees with
3 respect to the X axis and a first tilt angle of about -114 degrees to about -
4 116 degrees with respect to the Y axis.

1 12. The projection system of claim 10, wherein the third beam path
2 forms a second lateral angle of about -74 degrees to about -76 degrees with
3 respect to the X axis and a second tilt angle of about 64 degrees to about 66
4 degrees with respect to the Y axis.

1 13. The projection system of claim 10, wherein the fourth beam path
2 forms a third lateral angle of about 90 degrees with respect to the X axis and
3 a third tilt angle of about -79 degrees to about -81 degrees with respect to
4 the Y axis.

1 14. The projection system of claim 9, wherein the optical beam path
2 in the imaging unit resides in a housing and occupies a volume of about 5.5
3 inches³.